

WHAT IS CLAIMED IS:

1. A fuel cell apparatus comprising:

a fuel cell including an electrolyte membrane, a fuel electrode provided on  
5 one side of the electrolyte membrane and to which a fuel-containing  
material is supplied, and an air electrode provided on the other side of the  
electrolyte membrane and to which air is supplied;

a fuel cell cooling system for cooling the fuel cell by supplying a fuel cell  
cooling water to the fuel cell;

10 a hot water storage unit for supplying water for recovering heat generated  
upon operation of the fuel cell through heat exchange; and

a heat exchange unit including a laminated structure, a water entrance  
provided at the laminated structure and through which the water from the  
hot water storage unit flows into the laminated structure, and a water exit  
15 provided at the laminated structure and through which the water from the  
hot water storage unit is discharged out of the laminated structure after the  
water passes through the laminated structure; wherein the laminated  
structure of the heat exchange unit is integrally formed into lamination by a  
heat exchanger for the fuel cell cooling water for recovering heat in the fuel  
20 cell cooling water of the fuel cell cooling system and at least any one of a  
first heat exchanger for eliminating moisture contained in the fuel-  
containing material to be supplied to the fuel cell for power generation  
through the heat exchange, a second heat exchanger for eliminating

moisture contained in a fuel off-gas discharged from the fuel cell after the power generation through the heat exchange, and a third heat exchanger for eliminating moisture contained in an air off-gas discharged from the fuel cell after the power generation through the heat exchange.

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2. A fuel cell apparatus according to claim 1, wherein the heat exchanger for the fuel cell cooling water is provided close to the water exit of the laminated structure relative to the second heat exchanger.

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3. A fuel cell apparatus according to claim 1, wherein the second heat exchanger is provided close to the water entrance of the laminated structure relative to the heat exchanger for the fuel cell cooling water.

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4. A fuel cell apparatus according to claim 3, wherein the first exchanger is provided close to the water entrance of the laminated structure relative to the heat exchanger for the fuel cell cooling water.

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5. A fuel cell apparatus according to claim 4, further comprising:  
a reformer for generating the fuel-containing material, and wherein the laminated structure of the heat exchange unit includes a heat exchanger for a combustion exhaust gas formed into lamination for recovering heat in the combustion exhaust gas discharged from the reformer.

6. A fuel cell apparatus according to claim 5, wherein the third heat exchanger is provided close to the water entrance of the laminated structure relative to the heat exchanger for the fuel cell cooling water.

5     7. A fuel cell apparatus according to claim 6, further comprising a radiator for cooling the water before the water enters into the heat exchange unit, and wherein the fuel cell is provided on upper side of the laminated structure, which is arranged next to the radiator.

10    8. A fuel cell apparatus according to claim 1, wherein the first heat exchanger includes a first entrance formed at a lower portion of the first heat exchanger into which the fuel-containing material to be supplied to the fuel cell for the power generation enters, a first heat exchange passage through which the fuel-containing material flows upward, and a first exit  
15    formed at an upper portion of the first heat exchanger from which the fuel-containing material is discharged.

9. A fuel cell apparatus according to claim 8, wherein the second heat exchanger includes a second entrance formed at an upper portion of the  
20    second heat exchanger into which the fuel off-gas being discharged after the power generation enters, a second heat exchange passage through which the fuel off-gas flows downward, and a second exit formed at a lower portion of the second heat exchanger from which the fuel off-gas is discharged.

10. A fuel cell apparatus according to claim 9, wherein the third heat  
exchanger includes a third entrance formed at an upper portion of the third  
heat exchanger into which the air off-gas being discharged after the power  
5 generation enters, a third heat exchange passage through which the air off-  
gas flows downward, and a third exit formed at a lower portion of the third  
heat exchanger from which the air off-gas is discharged.

11. A fuel cell apparatus according to claim 10, wherein the heat exchanger  
10 for the fuel cell cooling water includes a fourth entrance formed at an upper  
portion of the heat exchanger for the fuel cell cooling water into which the  
fuel cell cooling water enters, a fourth heat exchange passage through which  
the fuel cell cooling water flows downward, and a fourth exit formed at a  
lower portion of the heat exchanger for the fuel cell cooling water from  
15 which the fuel cell cooling water is discharged.

12. A fuel cell apparatus according to claim 11, wherein the heat exchanger  
for the combustion exhaust gas includes a fifth entrance formed at an upper  
portion of the heat exchanger for the combustion exhaust gas, a fifth heat  
20 exchange passage through which the combustion exhaust gas flows  
downward, and a fifth exit formed at a lower portion of the heat exchanger  
for the combustion exhaust gas from which the combustion exhaust gas is  
discharged.

13. A fuel cell apparatus according to claim 12, wherein the first heat exchanger, the second heat exchanger, the third heat exchanger, the heat exchanger for the fuel cell cooling water, and the heat exchanger for the combustion exhaust gas are defined by plates each having a rectangular thin sheet shape.

14. A fuel cell apparatus according to claim 13, wherein each plates is formed by a plurality of convex portions and a plurality of concave portions being alternately arranged at a center portion of one side and the other side of each plate.